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ABSTRACT

This paper attempted to determine whether increasing technology, specifically a computer-based instructional approach, into the curriculum increases student learning, focusing on effects on student attitudes and self-efficacy. Participants were 47 fifth graders in a private school. One group received computer-based instruction in English grammar, and the other received computer-based instruction in mathematics. The instructional programs included drill and review. To determine self-efficacy and attitudes toward school, English, and mathematics, students completed the Student Opinion Survey (J. McMillan). Two other instruments were administered to provide evidence of convergent and discriminant validity. Findings suggest that the computer-based instruction increased student interest in school and learning in general. Students described an increase in satisfaction of learning with immediate responses. Implications for instruction are discussed in the context of the Massachusetts State Standards. Appendixes contain an Excel chart of study figures, the student opinion survey, and the Systat calculations. (Contains four figures, four tables, and nine references.) (SLD)

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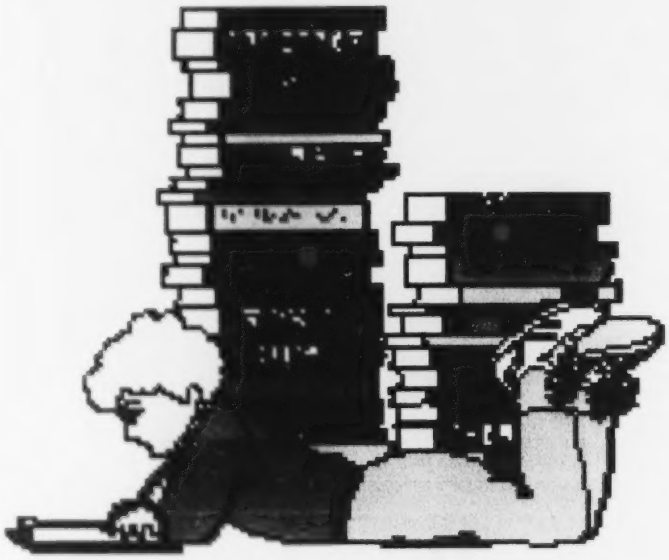

Does integrating technology into the curriculum increase student learning?

Jamillah Grant

June 10, 1998

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Does integrating technology into the curriculum increase student learning?

My research question is to determine whether increasing technology, specifically computer based instruction increases learning. If technology was introduced into the curriculum as a tool to enhance direct instruction through self directed drill and practice or tutorial programs, how will it benefit students? Would it effect student attitude about school in general? Would it effect student attitudes toward a particular subject if computer-based instruction were integrated into the curriculum? Does computer based instruction when added to traditional instruction strategies aide student understanding of the subject and foster an atmosphere of teamwork and cooperative learning?

The independent variable is a computer-based instruction. Computer programs were used in Grammar and Geometry. The dependent variables are student attitudes and self-efficacy about school in general and student attitudes and self-efficacy in regards to English and Math when integrated with computer-based instruction. The textual research examined showed a positive attitude toward the subject and a positive benefit in academic achievement. Using the null hypothesis, this study investigates whether integrating computer-based instruction promotes a positive attitude about English, Math and school in general.

Importance of Question

Millions are spent on educational software either for home entertainment or school use. The latter has not been wholly accepted and it is not fully integrated into the curriculum at the test site. Popular belief is that computer-based instruction increases student achievement and improves student attitudes toward learning. Federal programs to enhance the use of technology in schools is costing taxpayers over four hundred million dollars per year. President Clinton's "Call to Action for American Education in the 21st Century " speech (1997) pledged America's commitment to

technology in the classrooms. The goal was threefold to (a) connect every school to the internet (b) provide state of the art computers to teachers and students (c) and integrate technology into the curriculum. However, obtaining support from teachers will not be achieved without research to show that technology increases learning. (U.S. Department of Education, 1997).

Most research measures student achievement. Recent study outcomes show a relation between student achievement and student attitudes about school. Computer assisted instruction has had a positive effect on student attitudes about school (Office of Technology Assessment, 1995) Student skills include factors such as working cooperatively with others to achieve a common goal. Computer skills must also incorporate logical and critical thinking activities, to facilitate students' ability to differentiate between fact and opinion via the electronic media.

> Outcomes go beyond student achievement, because student achievement may be affected by students' attitudes about themselves, school, and learning. Other dynamics and types of interactions that go on in schools also play a part in learning. (Office of Technology Assessment 1995, p15).

New teacher programs are integrating technology into their curriculum. Teacher associations are advocating educational uses of technology in the classroom. Given the amount of money and time directed toward increasing technology in the classrooms, it seems appropriate to research the impact on student learning based on attitude and self-efficacy.

Industry's Role

Technology corporations are joining or creating educational foundations that offer grants for equipment to assist schools in meeting their technological goals. Firms such as Apple Computers, Lucent Technology, Cisco, and IBM are only of few of the many corporations with grants for schools.

Background

Based on the strongest studies, Cates and Goodling (1997), Brush (1997), and Young (1997), a well-written computer program is beneficial to students. In this study, preference was measured as a construct and as a learned continuous dependent variable. A survey of whether students preferred traditional methods to computer programs for learning spelling was administered, as well as open response interviews. Student showed improvement in the Young (1997) study. The study emphasized benefits of self-regulation obtained through computer use rather than academic gain. The result showed that computer based instruction had a positive effect on student performance regardless of who controls the program. The study by Ross, Smith and Morrison (1997) was positive in showing a long-term improvement in keyboarding, Math and English. The weak aspect of this study was the survey was subjective to the teacher's opinion about student improvement.

Setting and sample

The setting is a K-8 private school. Participants of this study were selected from a private school located in the northeastern suburbs of Massachusetts. The approximate population of the town is 39000. Approximately 17% of the town's children attend private school. The school selected for this study is a private school that has a student population of approximately 450. The teacher/student ratio is 1:25 with an occasional class of approximately 27 students.

The sample is a convenient cluster of two fifth grade classes. There are fifty-two students with ages ranging from 10 to 12 years old. Forty- seven of the students participated in the experiment with parental consent. The student population is multi-ethnic comprised of recent immigrants from Lebanon, Eastern Europe, Haiti, Dominican Republic, Africa, as well as third and fourth generation Americans representing diverse backgrounds. The community which is composed of 92.7% Caucasian, 5% Hispanic, 1.3 % Asian and less than 1% African and American Indian.

The socio-economic status is upper middle class. Exact ethnic and socio-economic demographics were not tallied at the school. However, it is believed that the school reflects the demographics of the town.

Data Collection and Analysis

Students participating in this study were administered the CTBS Standardized test, level 15 form A, Terra Nova by McGraw Hill, as part of the school district's annual testing program. The classes mean scores will be used as a pretest and data collection for the independent variable. Students were administered the CTBS test level 16 form A language arts sections as the posttest. Scoring of the posttest is not yet complete and will be included in later reports.

Two fifth grade classes participated, group B, (N=22) and group C, (N=27). Group B was a control group for English and group C was the control group for Math. The Treatment group C had integrated computer-based English in grammar. The program Grammar Renegades reinforced lessons directly related to classroom lessons. The program gave a series of sentences. The student had to find and highlight the error. If all errors were not found after three tries the computer would give the correct answer. A tutorial stating the grammatical rule appeared on the screen. If the answer was correct the first time, then an acknowledgment appeared on the screen.

The Math treatment group had direct instruction in fractions and geometry. The computer based math instruction was given as part of their classroom drill and practice. The program was a tutorial in identifying similar shapes. It drilled the steps to follow to detect a geometric pattern and a numerical pattern. After three attempts the computer would prompt the correct answer. Successful completion of the tutorial gave a triumphant sound and displayed a blue ribbon on the screen.

To determine self-efficacy and general attitudes toward school, English and Math, the students were given the Student Opinion Survey by James H. McMillan. This survey was based on a five point Likert scale. It was given before treatment and

immediately after treatment. The McMillan Student Opinion Survey was selected because it is a standard published survey that has been tested for validity and reliability to measure attitudes and self-efficacy toward learning. Validity was established by administering three drafts of the survey to students from two different schools to gather construct-related evidence. The Maiher Scale and the Minnesota School Affective Assessment were given to provide convergent and discriminant correlation for validity. Evidence of validity consisted of these commercially established reports. General attitude subscales correlation with subject matter subscales ranged from .37 to .43. Self-efficacy subject matter subscales ranged from .14 to .19. At the middle school level the average correlation for the same subject subscales was .35 and different subject subscales was .22. Reliability of the Student Opinion Survey was established by issuing the test retest method. Reliability was found to be satisfactory for each subscale and strong reliability for total attitudes and self-efficacy. The usability survey of principals and teachers showed good support for the survey. Most of the middle level administrators believed that the results of the Student Opinion Survey would be useful to improve student learning.

Study Design

Students were not randomly selected therefore; this is a quasi-experimental study design with pre and post control groups. All participants were gathered into one room to control any environmental differences. Each received the thirty-six questions Student Opinion Survey. The treatment group received computer-based instructions in English grammar daily for a three-week period. The treatment was applied immediately following the pretest. The posttest was given immediately following the treatment. As in the pretest, the posttest was administered to all participants in one room at the same time. The pretest and posttest were scored twice using an inter-rater to verify the data.

Data Analysis

Descriptive data showed that the mean for each group were similar. On the pretest, the Control group mean M=32.63 and the Treatment group mean M=34.28. The standard deviation measured 3.63 on the control group and 3.66 on the treatment group. Both group pretest and posttest showed a negative skew indicating slightly less than mean. Skews on the pretest-equaled -0.85 and on the posttest –1.00 for the Control group. Skews on the pretest equaled –0.99 and on the posttest –0.56 for the Treatment group. The shape of the distribution curve indicated a positive kurtosis (long tail) for all groups. Responses were ranked from 5 (always) to 1 (never). The frequency response showed (a) decrease in number of participants responding to the (rarely likes) category in the Treatment group, (b) a decrease in the number of participants responding to the (seldom likes) category, (c) and an increase in the number of participant responding to the (occasionally likes) category. Using the five- point Likert-scale, a quantitative analysis of the study was examined to determine whether there were significant levels of change.

Findings

Inferential data examined by calculating dependent t-test, ANOVA and ANCOVA. Two software programs were used to calculate the results, (a) the Excel Data Analysis tool kit and (b) the Systat computer program. Due to unequal variances, the Systat with Bartlett test for homogeneity was used to verify Excel results. Excel analysis tool kit was limited to a two-factor ANOVA. The Systat program analyzes multiple factor therefore the Systat program was used. A copy of the Excel two-way ANOVA is included in the charts to show that the results were similar.

Dependent t-tests determined whether pre-post gain of the group showed significant values in general attitudes toward school. An alpha level of .05 was used for all statistical tests. Excel measured T-statistic of 2.22 with a probability of p=0.032 and Systat results measured T-statistic of -2.293 with a probability of 0.027. Systat

measured a chi-square of 5.197 with degrees of freedom *df*=1 and probability p=0.023. $X2$ (1, N=47)=5.197, $p<.05$. To determine if there was a significant difference among the independent means a three-factor one-way analysis of variance was calculated. An analysis of variance (ANOVA) using the Systat program indicated an adjusted least square mean of LS M=32.15 for the Control group and LS M=34.54 for the Treatment group with a probability of p=0.023. The F test ratio was 5.536 for the sample with a value of mean square MS = 4.090 for between group interaction and a value of MS=63.414 for within group interaction. With alpha at $p<.05$ the null hypothesis was rejected because of significant levels of change in attitudes in general with p=0.023. The treatment group showed a positive significant change in the category of general attitudes toward school.

In regards to attitudes toward English the adjusted least mean for the control group LS M=36.729 and LS M=37.279 for the treatment group. Dependent t test regarding attitudes toward English did not show a significant change after treatment. (t = -0.639 with p= 0.526). Chi-square = 2.323 with p= 0.127, $X2$ (1,N=47)=2.323. Attitudes toward Math adjusted least square mean was 29.055 for the control group and 29.672 for the treatment group. Dependent t test regarding attitudes toward Math did not show a significant change after treatment. (t = -.709 with p=0.482). Chi-square =0.139 with p=0.709. $X2$ (1, N=47)= 0.139.

An analysis of variance ANOVA revealed post treatment probability values for dependent variables attitudes toward English p=0.519 and attitudes toward Math p=0.420. Statistics summaries in English and Math did not show a significant level of change for either group. Since the results of the ANOVA were significant in the general attitudes toward school group, the two groups were compared using a post hoc procedure. This was to determine whether there were pre-existing differences, which might account for the test results. An ANCOVA showed no considerable difference of between group responses using pretest scores as the covariant. Group B general

attitudes pretest mean M= 32.636 with a standard deviation of 3.632. Group C pretest mean M=34.280 with a standard deviation of 3.669. Therefore, evidence was provided that the groups were equivalent before treatment intervention.

Open Response Survey

Examination of individual test cases indicated that four students had extremely high posttest gains. A qualitative element examining what influences might account for these student attitudes becoming more positive toward school. These four students were interviewed to determine what influences played a part in their attitudes toward learning and whether these influences were measured in the resulting data. They were asked the following questions. The interviewer did not limit the responses to the questions. Answers are written in the vocabulary terms of the respondents.

1. What are your favorite things to do in general?
2. What are your favorite things to do in school?
3. What do you like about your favorite subject? Why?
4. Do you have a computer in home?
5. Does your parents use a computer at home or work?
6. Name some of the things you would like to learn?
7. How would you learn them?

In reply to question 1, reading was a common element in favorite things to do in general, with two out of four indicating that they like reading mysteries. Question 2, favorite things to do in school obtained a variety of answers with Math and recess included four out of the four responses. Question 3, Computer class was indicated as their favorite subject. When asked the reason computer was their favorite, four out of the four students indicated they liked to know when they got the right answer and they liked that after three times the computer gave them the right answer and showed them what to do. Question 4, three out of four students had access to a computer at home. Question 5, all of the students indicated that their parents used a computer at work.

Question 6, three out of the four students indicated they would like to learn keyboarding. One student was proficient, yet self taught in keyboarding skills. Other answers included wanting to learn more about Art, Science and Social Studies and wanting to increase their reading in order to know more words. Question 7, none of the four students interviewed indicated using computers to learn what they might want to learn. None of the students interviewed directly associated the integration of computer-based instruction with their increase in affinity toward school.

Discussion

The implication of these results is that computer-based instruction integrated into the curriculum increases student interest in school and learning in general. That interest may not be immediately interpreted into increase interest in any specific subject. Students described an increase in satisfaction of learning with immediate responses.

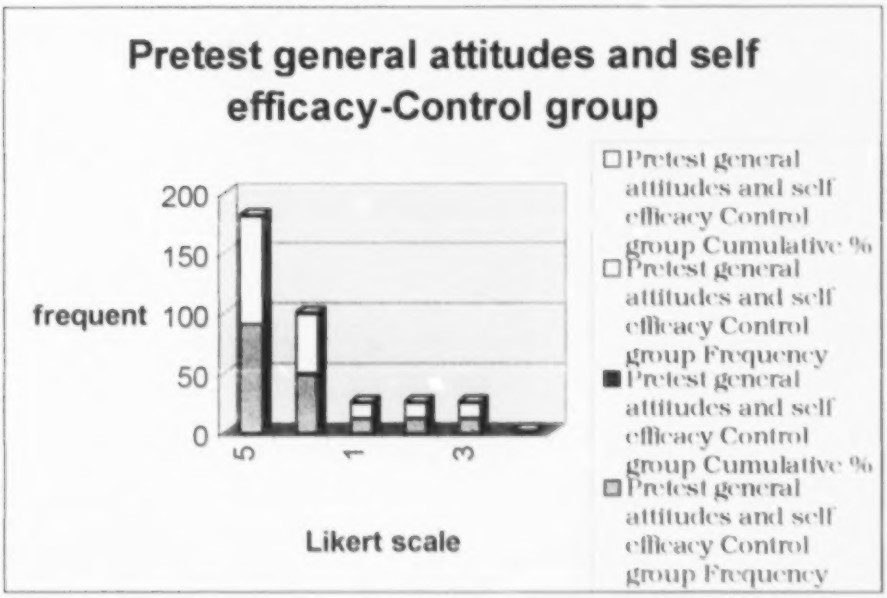
Future studies might consider the following questions. Would individual attention to students and immediate response from the teacher have the same effect? Would student affinity toward a specific subject increase given an expanded period of time? Since subject affinity did not change due to computer based instruction, further studies could focus on the role of the teacher in (a) promoting affinity toward a subject, (b) promoting attitudes toward technology, and (c) encouraging the use of technology as a tool for lifelong learning.

Integrating computer-based instruction into the curriculum would incorporate Guiding Principles I, III, V, and VI of the Massachusetts State Standards. Principle I calls for learning to be fun and enjoyable. Principle III states that learning should show a connection to real life and promote learning as lifelong endeavor. Principle V deals with the social development which results from working in groups. Principle VI states that technology is an essential component of education. (Massachusetts Department of Education, 1997)

Data Analysis

Pretest general attitudes and self efficacy
Control group

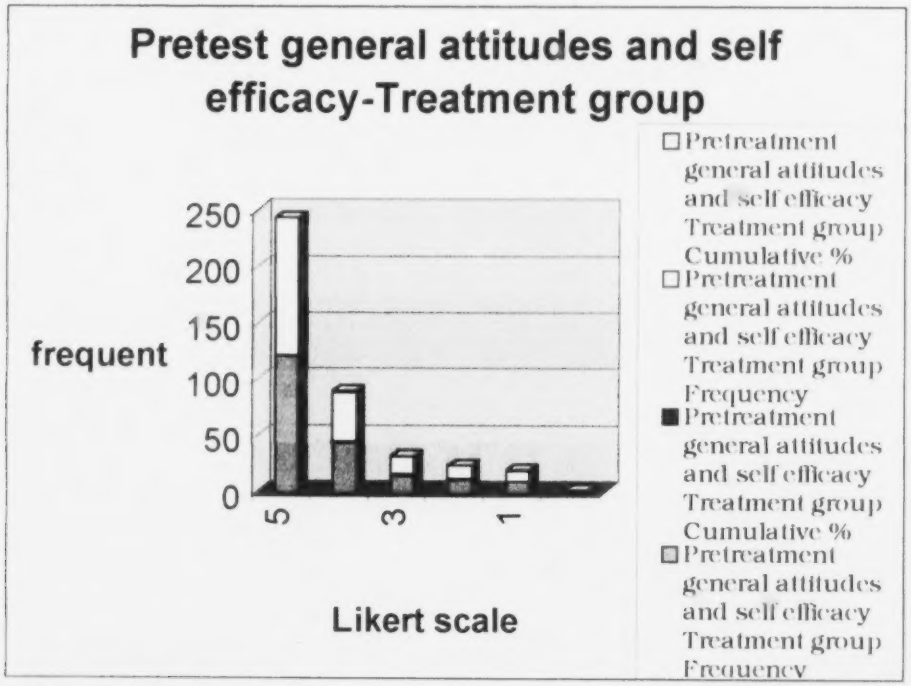
Likert Scale	*Frequency*	*Cumulative %*	*Likert Scale*	*Frequency*	*Cumulative %*
1	12	6.86%	5	90	51.43%
2	12	13.71%	4	49	79.43%
3	12	20.57%	1	12	86.29%
4	49	48.57%	2	12	93.14%
5	90	100.00%	3	12	100.00%
More	0	100.00%	More	0	100.00%



Data Analysis

Pretreatment general attitudes and self efficacy
English Treatment group

Likert Scale	*Frequency*	*Cumulative %*	*Likert Scale*	*Frequency*	*Cumulative %*
1	9	4.50%	5	121	60.50%
2	11	10.00%	4	44	82.50%
3	15	17.50%	3	15	90.00%
4	44	39.50%	2	11	95.50%
5	121	100.00%	1	9	100.00%
More	0	100.00%	More	0	100.00%



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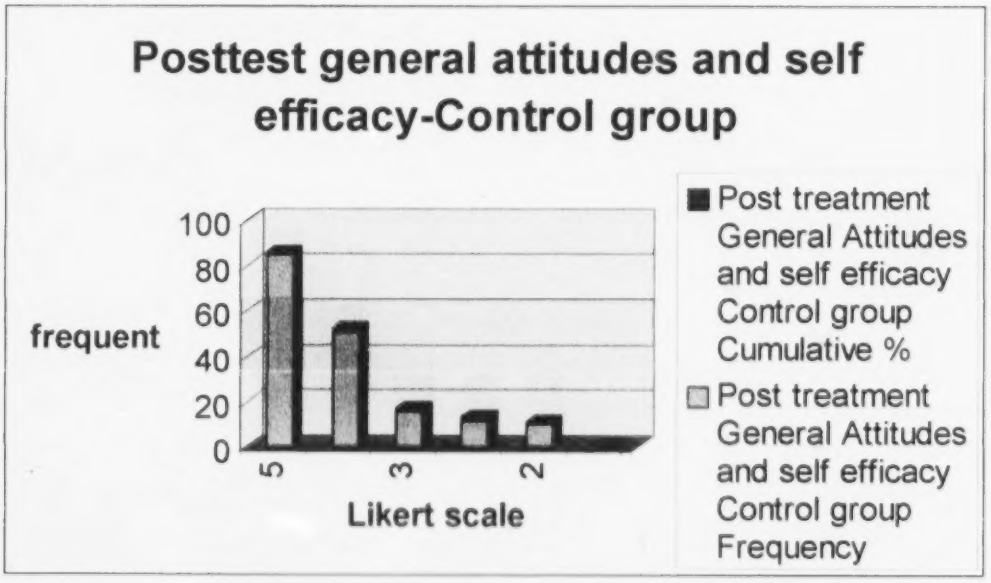
Data Analysis

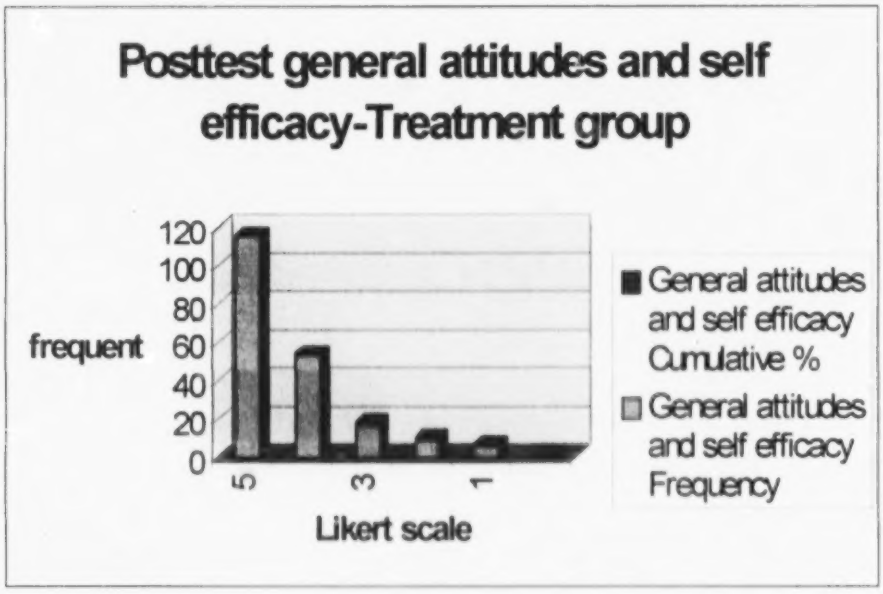
Posttest general Attitudes and self efficacy
English
Control group

0	Frequency	Cumulative %	0	Frequency	Cumulative %
1	12	6.90%	5	85	48.85%
2	10	12.64%	4	51	78.16%
3	16	21.84%	3	16	87.36%
4	51	51.15%	1	12	94.25%
5	85	100.00%	2	10	100.00%
More	0	100.00%	More	0	100.00%



Post treatment general attitudes and self efficacy
English Treatment group

Likert Scale	*Frequency*	*Cumulative %*	*Likert Scale*	*Frequency*	*Cumulative %*
1	6	3.00%	5	115	57.50%
2	9	7.50%	4	53	84.00%
3	17	16.00%	3	17	92.50%
4	53	42.50%	2	9	97.00%
5	115	100.00%	1	6	100.00%
More	0	100.00%	More	0	100.00%



Data Analysis

Pre-treatment	
Control group general attitudes and self efficacy	
Mean	32.63636364
Standard Error	0.774444235
Median	33.5
Mode	34
Standard Deviation	3.632465443
Sample Variance	13.19480519
Kurtosis	1.03567583
Skews	-0.850976226
Range	15
Minimum	23
Maximum	38
Sum	718
Count	22

Post-treatment	
Control group general attitudes and self efficacy	
Mean	32.22727273
Standard Error	0.877648911
Median	33.5
Mode	34
Standard Deviation	4.116538284
Sample Variance	16.94588745
Kurtosis	0.431419591
Skews	-1.003109737
Range	15
Minimum	22
Maximum	37
Sum	709
Count	22

Pre-treatment	
Treatment group general attitudes and self efficacy	
Mean	34.28
Standard Error	0.733757453
Median	35
Mode	35
Standard Deviation	3.668787266
Sample Variance	13.46
Kurtosis	1.439414934
Skew	-0.991333591
Range	15
Minimum	24
Maximum	39
Sum	857
Count	25

Post treatment	
Treatment group general attitudes and self efficacy	
Mean	34.48
Standard Error	0.503719499
Median	35
Mode	35
Standard Deviation	2.518597493
Sample Variance	6.343333333
Kurtosis	0.275427594
Skew	-0.561266038
Range	10
Minimum	28
Maximum	38
Sum	862
Count	25

t-Test: Two-Sample Assuming Unequal Variances

General attitudes toward school and learning

Pretreatment	*Treatment group*	*Control group*
Mean	34.28	32.63636364
Variance	13.46	13.19480519
Observations	25	22
Hypothesized Mean Difference	0	
df	44	
t Stat	1.540647711	
P(T<=t) one-tail	0.065282163	
t Critical one-tail	1.680230071	
P(T<=t) two-tail	0.130564326	
t Critical two-tail	2.0153675	

General attitudes toward school and learning

Post treatment	Treatment group	Control
Mean	34.48	32.22727273
Variance	6.343333333	16.94588745
Observations	25	22
Hypothesized Mean Difference	0	0
df	34	
t Stat	2.226170576	
P(T<=t) one-tail	0.016367759	
t Critical one-tail	1.690923455	
P(T<=t) two-tail	0.032735517	
t Critical two-tail	2.032243174	

t-Test: Two-Sample Assuming Unequal Variances

General attitudes toward school and learning

Pretreatment	*Treatment group*	*Control group*
Mean	34.28	32.63636364
Variance	13.46	13.19480519
Observations	25	22
Hypothesized Mean Difference	0	
df	44	
t Stat	1.540647711	
P(T<=t) one-tail	0.065282163	
t Critical one-tail	1.680230071	
P(T<=t) two-tail	0.130564326	
t Critical two-tail	2.0153675	

General attitudes toward school and learning

Post treatment	Treatment group	Control
Mean	34.48	32.22727273

Variance	6.343333333	16.94588745
Observations	25	22
Hypothesized Mean Difference	0	0
df	34	
t Stat	2.226170576	
P(T<=t) one-tail	0.016367759	
t Critical one-tail	1.690923455	
P(T<=t) two-tail	0.032735517	
t Critical two-tail	2.032243174	

t-Test: Two-Sample Assuming Unequal Variances

English pretreatment	*Treatment group*	*Control group*
Mean	36.92	36.90909091
Variance	7.243333333	6.848484848
Observations	25	22
Hypothesized Mean Difference	0	
df	45	
t Stat	0.014071525	
P(T<=t) one-tail	0.49441756	
t Critical one-tail	1.679427442	
P(T<=t) two-tail	0.988835121	
t Critical two-tail	2.014103302	

t-Test: Two-Sample Assuming Unequal Variances

English Post treatment	*Treatment group*	*Control group*
Mean	37.28	36.72727273
Variance	11.29333333	5.826839827
Observations	25	22
Hypothesized Mean Difference	0	
df	43	
t Stat	0.652943521	
P(T<=t) one-tail	0.258634354	
t Critical one-tail	1.681071353	
P(T<=t) two-tail	0.517268708	
t Critical two-tail	2.016690814	

t-Test: Two-Sample Assuming Unequal Variances

Math pretreatment	*Treatment group*	*Control group*
Mean	29.36	29.68181818
Variance	11.40666667	8.036796537
Observations	25	22
Hypothesized Mean Difference	0	
df	45	
t Stat	-0.355047787	
P(T<=t) one-tail	0.362106261	
t Critical one-tail	1.679427442	
P(T<=t) two-tail	0.724212522	
t Critical two-tail	2.014103302	

t-Test: Two-Sample Assuming Unequal Variances

Math post treatment	*Treatment group*	*Control group*
Mean	29.64	29.09090909
Variance	6.49	7.61038961
Observations	25	22
Hypothesized Mean Difference	0	
df	43	
t Stat	0.705630864	
P(T<=t) one-tail	0.242111573	
t Critical one-tail	1.681071353	
P(T<=t) two-tail	0.484223147	
t Critical two-tail	2.016690814	

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Appendices

ANOVA chart using Excel

Student Opinion Survey

Systat calculations

ANOVA: Two-Factor With Replication

POST TREATMENT RESULTS

SUMMARY	GENERAL	ENGLISH	TOTAL
Count	25	25	50
Sum	726	812	1538
Average	29.04	32.48	30.76
Variance	128.7066667	155.8433333	142.3902041

Count	25	25	50
Sum	857	923	1780
Average	34.28	36.92	35.6
Variance	13.46	7.243333333	11.91836735

	Total	
Count	50	50
Sum	1583	1735
Average	31.66	34.7
Variance	76.63714286	84.90816327

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	585.64	1	585.64	7.674150432	0.006725932	3.940158422
Columns	231.04	1	231.04	3.027518127	0.085067838	3.940158422
Interaction	4	1	4	0.05241548	0.819399252	3.940158422
Within	7326.08	96	76.31333333			
Total	8146.76	99				

STUDENT OPINION SURVEY (Middle Form)

Directions: These are some questions about how you feel about your school, learning, and some subjects you study.

Read each sentence and then answer it by CIRCLING the letter(s) that show(s) how much each one is TRUE for you.

If the statement is ALWAYS TRUE, circle A.

If the statement is ALMOST ALWAYS TRUE, circle AA.

If the statement is OFTEN TRUE, circle O.

If the statement is SOMETIMES TRUE, circle S.

If the statement is NEVER or RARELY TRUE, circle R.

For example, if you are asked:

I like popcorn.

And you always like popcorn, circle A:	A	AA	O	S	R
If you almost always like popcorn, circle AA:	A	AA	O	S	R
If you like popcorn often, circle O:	A	AA	O	S	R
If you like popcorn sometimes, circle S:	A	AA	O	S	R
If you almost never like popcorn, circle R:	A	AA	O	S	R

SECTION I: Answer these questions about school and learning in general.

1. I believe the things I learn in school are important. A AA O S R
2. *If I want I can do well in any school subject.* A AA O S R
3. I am confident that I could make the honor roll each semester. A AA O S R
4. I work hard to get good grades. A AA O S R
5. It is easy for me to do all the work in all my school subjects. A AA O S R
6. I expect to do very well in school A AA O S R
7. I spend extra time in the library working on projects. A AA O S R
8. I work hard in school because learning is important. A AA O S R

SECTION II: Answer these questions about English, Math, and Science.

9. I spend some of my free time reading for my own enjoyment. A AA O S R
10. It is important to understand math. A AA O S R
11. Understanding science helps me to understand what happens around me. A AA O S R
12. I can do all the work in my English class without any problems. A AA O S R
13. I am confident that I can answer the questions asked in math class. A AA O S R
14. I do all my English homework. A AA O S R
15. With calculators and computers I really don't need to know much math. A AA O S R
16. I always complete my science homework. A AA O S R
17. The books and other things we have to read for English are easy for me. A AA O S R
18. If I want I can get good grades in science. A AA O S R
19. English is a waste of time and I do just enough work to get by. A AA O S R
20. Performing well in math class is important to me. A AA O S R
21. Science is only useful to people who want to be scientists. A AA O S R
22. If I want I can get good grades in English. A AA O S R
23. I can do the work given to me by my science teacher. A AA O S R
24. When I don't understand something in my English class I ask the teacher questions. A AA O S R
25. It is important for me to be good at math. A AA O S R
26. I understand everything in my English class. A AA O S R
27. It is easy for me to do math problems that other students find difficult. A AA O S R
28. I need help from others to do my science homework. A AA O S R
29. Math is easy for me to understand. A AA O S R
30. I participate and contribute in my science class. A AA O S R
31. No matter how hard I try, I have trouble with English. A AA O S R

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32.	Science tests are hard for me.	A AA O S R
33.	The things I learn in science are important.	A AA O S R
34.	No matter how hard I try, I have trouble with Math.	A AA O S R
35.	No matter how hard I try, I have trouble with Science.	A AA O S R
36.	The things I learn in English are important.	A AA O S R